'Raising the Temperature': The Arts in a Warming Planet

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Abstract

The search for decisive actions to remain below 1.5°C of global temperature rise will require profound cultural transformations. Yet our knowledge of how to promote and bring about such deep transformative changes in the minds and behaviours of individuals and societies is still limited. As climate change unravels and the planet becomes increasingly connected, societies will need to articulate a shared purpose that is both engaging and respectful of cultural diversity. Thus, there is a growing need to "raise the temperature" of integration between multiple ways of knowing climate change. We have reviewed a range of literatures and synthesized them in order to draw out the perceived role of the arts in fostering climate transformations. Our analysis of climate-related art projects and initiatives shows increased engagement in recent years, particularly with the narrative, visual and performing arts. The arts are moving beyond raising awareness and entering the terrain of interdisciplinarity and knowledge co-creation. We conclude that climate-arts can contribute positively in fostering the imagination and emotional predisposition for the development and implementation of the transformations necessary to address the 1.5°C challenge.

1. Introduction

Attempts to stay below a 1.5ºC global temperature rise will require profound cultural transformations. While climate scientists and economists seek to identify scenarios in which there is a chance of meeting the 1.5ºC target [1-3], other areas of knowledge and culture are developing approaches to engage critically and expand the imaginative foundation for possible pathways that would allow us to reconnect human prosperity to the dynamics of Earth's ecosystems [4-7].

As climate change impacts biophysical, social, economic and political systems, it is best seen not solely as a technical problem but as a challenge requiring cultural, adaptive and creative responses [1,8], in which transformations in social-ecological systems are a key strategy to mitigate and adapt to climate change [9]. Transformations are conceptualized and studied in diverse ways but overall they refer to fundamental changes in structure, function and relations at the personal, political and practical spheres of interdependent social, ecological and technical systems, leading to new patterns of interactions and diverse outcomes [10-12]. When applied to global sustainability, the notion of transformations is commonly used to claim that fundamental changes in current social-ecological systems are necessary (ibid). Cultural transformations are those that affect the cultural roots of groups and societies, including beliefs, behaviours, values and worldviews [13-16].

In the quest for transformative change, many have recognized the need for mobilizing multifaceted sources of knowledge and value systems to provide a robust understanding of the complexities of climate change and generate multiple pathways toward sustainable and equitable social-ecological systems [17]. However, there is limited understanding of how to do that in practice. Despite increasing interest in the "human dimension" of global environmental change across a variety of disciplines [8,18-23], the arts are a forgotten dimension in IPCC reports: a word search in IPCC AR5 shows that the term "arts" (in the sense of artistic practice) does not appear [24]. In this article, we position the arts as key contributors to processes related to social learning, as they are particularly well-suited to give access to sources of knowledge and to drive action relevant for climate transformations. We

first review the most recent literature on climate-related art and examine artistic projects undertaken over a 17-year time period (2000-2016).

2. Why do the arts matter on a warming planet?

A world where the increase in average global temperatures is limited to only 1.5^{o}C above pre-industrial levels requires a wide range of innovative actions in specific contexts. Current climate change research seeks to inform and help societies address the critical biophysical and social challenges brought on by global warming. So far, this work has focused on managing carbon emissions and adaptating to climate impacts [14]. Despite advances in climate adaptation literature, limited knowledge is available on how to promote and bring about transformative changes in the cultural dimensions of climate change [20].

Scholars have called for strengthening the integration of social sciences and the humanities in global environmental change research [23,25-27] or for a "cultural turn" in climate change action [22]. This is related to the growing realisation of the inability of dichotomies such as those between fact/value or nature/culture to make sense of the objects of sustainability and to prompt broader and more significant engagements towards social-ecological transformations [7,18]. Various disciplines in the social sciences and humanities have begun to frame climate change as a dynamic cultural and societal force capable of re-shaping humanity's relationship with nature, and spurring a deeper inquiry into the existential aspects of human life [8,28] (Figure 1).

{ FIGURE 1 HERE }

Figure 1. An artistic illustration of climate change as a cultural and societal force capable of spurring inquiries into a wider range of aspects of human life.

Along similar lines, some authors have called for a "humanistic climate response" that understands people as the solution [29] and pays attention to the human experience: affect and emotions, human values, subjectivity and the possibilities for the fulfilment of human

potential [30]. Increasingly, we observe a discursive shift towards an understanding that both the impacts of and solutions to climate change are deeply mediated by culture [31]. Researchers are beginning to see cultural change as a set of key learning mechanisms from which possible solutions to climate change could emerge [29]. In this sense, the 1.5ºC challenge is the ultimate expression of our "learning race" towards sustainability [32]: Will societies learn fast enough to meet the multifaceted changes in beliefs, perceptions, behaviours and practices required for climate transformations?

The multifaceted challenges of climate change cannot be addressed by science alone. It is often easier to provide risk assessments and model the problem than to agree on the actions that need to be taken in specific contexts to address those risks. Sound decisions depend on both factual understanding and values [33]. Improving societies' capacities to respond to climate change requires an open and engaging transdisciplinary processes with large and diverse populations aimed at sharing experiences, co-creating knowledge and reimagining public goals [20]. While the effective communication of climate science is an important component of public mobilization, and making climate change more personally relevant has been suggested as a key predictor for climate change engagement [34], public engagement hinges on complex social and psychological mechanisms [35,36]. Due to the nature of climate change [19], individuals face "psychological barriers" with regard to mitigation and adaptation actions [36] in addition to economic and communication challenges. As such, inclusive processes and methods that go beyond conventional science communication and fear-inducing representations [37] are required to make climate change meaningful for large numbers of people in the shared quest for transformation.

The creation of meaning involves more than narrowly-defined cognitive (i.e. logico-deductive) aspects of climate change; it calls for the inclusion of ethical, affective and aesthetic knowledges, which affect how humans interpret and assign value to certain aspects of the world [23,38]. Inasmuch as engagement with climate change goes beyond an understanding of the biophysical phenomena to encompass care and multiple forms of connection, the arts could provide a powerful conduit for such engagement [39].

Historically, artists and artistic practices have played a central role in major societal transformations by heralding shifts in mindsets, opening up new political horizons and providing – sometimes even forcing – the creation of novel spaces for reflexivity and

experimentation [40]. Art has confronted humanity's greatest challenges, such as war, inequality, disease, and many others, providing social spaces for grief and reconciliation and the renewal of human consciousness [41-43]. A unique characteristic of artistic inquiry is its ability to engage with more-than-rational, non-reductive knowledge and experiences of the world in their living qualitative complexity. As such, it reveals layers of partly contradictory dynamic tensions beyond orderly conceptual models [21] thereby making questions more relevant and exploring their existential values [44] rather than short-circuiting them in the search for "solutions" [45]. Many forms of artistic expression seek to address such complexity while not being off-putting [46,47].

To the extent that social change occurs first in emotions and second in people's minds (rationales and moral judgement), artistic engagement can be central to climate change-related societal transformations. It is of no surprise therefore that climate-related art has emerged as a cultural response to the social, behavioural and political challenges posed by climate change. Artistic practices offer *"possibilities for revealing limitations of existing knowledge systems and foster experiences that promote novel ways of understanding and responding to climate change, more attentive to our embodied, imaginative and emotional experiences"* [42].

3. The reach of climate-related arts

In global change and sustainability literature, arts have been argued to play a variety of roles in transformations (Table 1). These relate to the potential of art experiences to open up creative engagement, support reflexivity and act as a principal conduit for cultural renewal. Art may extend climate change engagement towards the affective and personal experience, which may become a force that can help close the gap between what we know and what we actually do about climate change [15,48].

Table 1. Dimensions of climate change transformations processes possibly accessible through the arts. Source: Author

Dimensions	**Potential role of the arts**	**References**

Creative imagination and serendipity	Potential to create spaces for active experimentation and imagination, fostering creative thinking. Serendipity is an integral part of emergent and resilient responses	[21]
Dealing with difficult emotions and dilemmas	Create safe spaces of disclosure and sharing	[38,49,50]
Engaging storytelling	Narratives combine cognitive with emotional resources in the depiction of specific experiences, offering increased comprehension, interest and engagement of audiences	[51]
Science communication	Enrich narrative, visual and experiential aspects of communication and extend its reach	[52,53]
Possibilities for political engagement	Hybrid experiences that bring together art, science and climate change can be fertile ground for collective action by creating sites of encounter, public scrutiny, meaning negotiation and trust	[54]
Exploring futures imaginatively	Develop metaphors, imagery and narratives of alternative futures	[55]
Pre-figuring potential futures through direct action	Develop and perform direct intervention, experimentation and re-designing in daily situations and social systems	[56]
Engaging with values and beliefs	Unveil values and beliefs behind action and perception, connecting with personal and collective drivers of action	[36]
As part of transdisciplinary learning processes of knowledge integration	Artists as active participants of a transdisciplinary process integrating multiple learning and processes and involving multiple ways of knowing	[56,57]
Shifting awareness and openness to more-than-human worlds	The arts may provide access to different sources of cognitive, emotional and sensual experience, opening up sensibilities to extended ecologies and more-than-human worlds	[58,59]
Coupling cultural systems with social-ecological change	Art can reveal materially and directly what is happening in social-ecological systems which may lead to the attuning of human perception, value systems and worldviews to changes in the biosphere	[6,60]

Embracing social-ecological complexity	Art embraces uncertainty and tends to trace the ways in which society and nature are intertwined. This approach may open up alternative modes of relations to nature beyond "command-and-control"	[21,61]

Climate art is growing within the diversity of contemporary artistic approaches [62-64]. Climate-related art is connected to other artistic traditions like "land art" and the art movements that emerged from the 1960s and 1970s environmental movement, and to work in the arena of art-science [54]. Earlier artistic engagements with global climate change emerged from the genre of "ecological art" from the late-1970s, with work such as "Lagoon Cycle" (1974-1982) by Helen and Newton Harrison and some of their more recent work [65]. The topic then became widespread in photography and film, as exemplified by the documentary "An Inconvenient Truth", which was a central piece of awareness raising in the late-2000s [66].

More recently, there has been a proliferation of different art forms engaging with the topic of climate change. In this review, we explore these developments by mapping out recent initiatives that deal explicitly, at least in part, with the topic of climate change, either in content or form, or as articulated by the creators.

We compiled a catalogue of artworks – processes or outcomes of a specific art practice – and art projects – initiatives, exhibitions and on-going networks of artistic curation and collaboration. The primary sources for the catalogue entries came from expert consultations and Internet searches in English and Spanish (see supplementary material for extended methodological considerations). Keywords search included the generic "climate change and art" and specific art forms, such as "climate change and film" or "climate change and theatre". Focusing on the years 2000-2016, we surveyed 199 climate artworks and 102 climate art projects and initiatives from around the world. We chose art initiatives that deal explicitly, at least in part, with the topic of climate change, either in content or form, or that are defined as such by their creators. The goal of this analysis was to elucidate the ways in which the arts have contributed to climate change mitigation, adaptation and transformations.

Since the early 2000s, the number of climate art engagements has significantly increased (Figure 1 and Figure 2). The years 2009 and 2015 were particularly active years, perhaps because of decisive UNFCCC COP meetings where heads of states attended the climate negotiations in person. Although not comprehensive, our catalogue shows greater activity in the US, UK and France. Art projects and initiatives generally span multiple disciplines. The majority of artworks are in literature, theatre, film and installations (Figure 4).

We analysed the descriptions of climate art projects to understand projects' goals and gain insight into the way artists and project leaders view their contribution to climate transformations. The objective of this analysis is not to propose a framework of categories but to offer insight on the range of orientations that drive climate art engagements. A caveat here is that the context of artistic production is very complex, and a particular project might have several goals and those goals may be only loosely defined [53]. We identified five major clusters of partially overlapping project orientations. About half of the climate art projects we found aim to create a new intellectual and emotional awareness of climate change; they use the arts as a means to visualize planetary change and shift perceptions of climate effects and risks. Some of these initiatives envision art as a process that helps people engage with climate change on a deeper emotional and personal level. These initiatives address the challenging emotions caused by climate change like hopelessness, sadness, loss, grief and trauma. Another portion (about 18%) of recent projects seek to foster dialogue amongst and between various sectors and to create extended networks amongst artists, scientists and society, e.g., promote transdisciplinary practices. These projects often explore new vocabularies to conceive and speak about climate change, and new ways of relating to the world. Related to this, a third cluster of projects is focused on using creativity, inspiration, positive stories and support thinking towards finding practical solutions. Yet another set of projects (a further 18% of entries) concentrates on imaginative futures and visioning. In fact, a climate change science fiction genre (cli-fi) has emerged [67].

{ FIGURE 2 HERE }

Figure 2. Here, we illustrate the increase over time in the number of art projects present in the compiled climate-related art catalogue. These are growing networks of initiatives, cultural actors, artists and practitioners.

{ FIGURE 3 HERE }

Figure 3. Representation of the number of artworks present in the climate-related art catalogue.

Though this would require further exploration that is beyond the scope of this review, we noticed that the most prominent biophysical phenomena featured in artworks are the melting ice in the Arctic and the rising seas. There seems to be less focus on other issues such as ocean acidification, loss of species diversity and emergence of infectious diseases, for example. Two-thirds of the projects we found related to visualizing the planet's changing ecosystems deal with the Arctic. This suggests that artistic production has been greater in relation to changes in certain geographical areas and not others. Public imagination (at least in the West) and imagery of climate change might be biased towards certain areas, and climate change might be perceived as, or imagined to be, a limited set of biophysical changes, e.g. melting ice and sea level rise.

{ FIGURE 4 HERE }

Figure 4. Art forms present in the climate-related art catalogue.

4. Raising the temperature on knowledge integration: *More-than-rational* ways of thinking and acting

In the early 2000s, there were already calls for artists to engage with climate change [68] as it was becoming apparent that climate science alone was not sufficient to motivate the public and politicians to act across multiple scales [69]. In the last decade, artistic engagement with climate change has been framed primarily through its ability to provide an accessible channel

to connect with phenomena that are unpredictable, often difficult to comprehend and seem remote in time and space. Awareness-raising has been a major component of these early works, although a few of them were met with criticism because they arguably generated a sense of powerlessness [68].

Our review reveals increased artistic activity in a variety of expressive forms especially from the late 2000s onwards (Figure 2). Although the role of the arts in climate change transformations has been stated as needed repeatedly, there are relatively few studies on the impacts of artistic engagement with climate change. We are also doubtful whether such studies could even be designed given the limited availability of social science tools and methodologies. Our review gained insight about the general orientations of these projects, but it does not assess whether particular goals were achieved and how these achievements might have contributed to transformations. Such research would require more clearly stated goals from the projects, and a broad assessment approach, involving multiple methods [53]. Another approach would be to develop artworks and forms of artistic expression as part of a research project explicitly designed from the onset to address these critical and as yet unanswered questions.

We also observe a wave of artistic initiatives and projects, mostly in Europe, focused on, or containing a strong component of, co-creation and co-design by scientists, artists, practitioners and communities in the development of knowledge and solutions (about 20% of projects have such qualities). These projects emphasize broad dialogue rather than awareness raising. They unfold through the practice of transdisciplinarity and futures-making, and use the freedom of artistic practices to expand the epistemological repertoire and explore dimensions and facets of climate change that are not accessible through standard scientific methods.

One example is the interactive art installation “Sustainability in an Imaginary World” [70]. Co-designed by scientists and artists, the work distinctly moves beyond the notion of ‘sharing information’ about a problem to deliberately make use of the aesthetic experience of audiences to pose questions of experience, affect, creativity and self-reflection. As a result [70], the project embraced a plurality of meanings about the future, while seeking to empower audiences to imagine plural futures. Another example [71] is the use of participatory drama to understand sources of vulnerability, risks and resilience in communities in Kenya.

Although admittedly in the early stages of development, these multidisciplinary projects suggest that the arts can play an important role in "raising the temperature" in social learning, cultural innovation and knowledge integration relevant to climate transformations [20]. In this second wave, climate-related art is not solely communicative; it is a process of opening up imaginative spaces where audiences can move more freely and reconsider the role of humans as responsible beings with personal agency and stakes in a changing world. Artistic engagements may therefore be able to bring to the surface, often in unique ways, the assumptions underpinning different knowledge systems, beliefs as well as the affective, ethical and moral dimensions of climate change. The arts may operate as "spaces of possibility", accelerating systemic and institutional (social, political and cultural) innovation [52,56]. Because of their wide reach and freedom to explore multiple realities, artistic practices are able to link climate change to a variety of other human challenges, potentially developing more meaningful forms of engagement. The range of potentially devastating impacts of climate change across vast areas of society requires spaces for reflection that invite citizens to frame such challenges in ways that make sense and are relevant to them. Artistic works are usually concerned with deepening questions rather than providing answers and solutions. This quality can be fundamental in the co-creation of innovative solutions to address the current climate quandary. In this sense, the arts represent a potential public space that can open up the framing of a particular problem, rather than closing down the possibilities for action, limiting solutions, and presenting problems framed exclusively by experts.

5. Conclusion

Social learning, a key component of climate transformations, requires spaces of creativity and innovation. Artists have been working to make climate change culturally meaningful both at the very personal and collective levels. We found an increasing number of artworks, projects and networks on climate-related arts, especially in the last decade. These cultural and creative engagements suggest the potential of the arts to inspire and open up multiple ways of engaging large amounts of people with the challenge of climate change.

Earlier work was primarily concerned with raising awareness about the biophysical phenomena of climate change. In recent years, artistic engagements have sought to develop

knowledge integration processes, in particular through the practice of imaginative futures and performance. Claiming that arts have an important role to play in transformations does not mean to approach art in an instrumental way. On the contrary, what makes art a unique contributor is its freedom to pursue open-ended explorations of any topic through an ever-expanding set of practices not wedded to finished 'outcomes' or 'solutions'. This is an important aspect to keep present while there is also a need to research the actual agency and contribution of artistic processes in particular contexts of societal climate transformations. Art in climate transformations is best seen as an open inquiry process, unconstrained by standard scientific methods, and involving not just artists and scientists but also communities and change agents across multiple domains of action. Its unique qualities lie in challenging taken-for-granted convictions, often in an engaging and creative way, a process that can lead to new ways of perceiving, understanding and acting upon climate change.

It is in this way that the arts can play a unique role in the integration of knowledge, emotions and moral judgement to support social learning in the face of the global climate threat. Future research could seek to better understand the actual contribution of artistic processes as path-making strategies in societal climate transformations. The arts provide fresh approaches that can support societies in thinking, feeling and narrating their experiences of complex issues of socio-ecological change. Artistic engagements are becoming sites of active experimentation, enacting novel social-ecological relationships and leading to more-than-rational explorations of current systems and possible futures. They create spaces in which the normative aspects of climate change can be addressed, and thus negotiated and redefined through collaborative processes. This may empower citizens to take an active role in co-constructing the meaning of nature in society, and it may also help to reframe current risks and vulnerabilities as spaces for social innovation.

In short, moving towards a future that remains below a 1.5^{o}C global temperature rise requires developing "narratives of hope" [72]. Art can provide a means to envision, express and shape the kind of society we collectively want to create. In this sense, climate change becomes an opportunity to open up spaces of collaboration and innovation, and to transform our relationship to the planet Earth.

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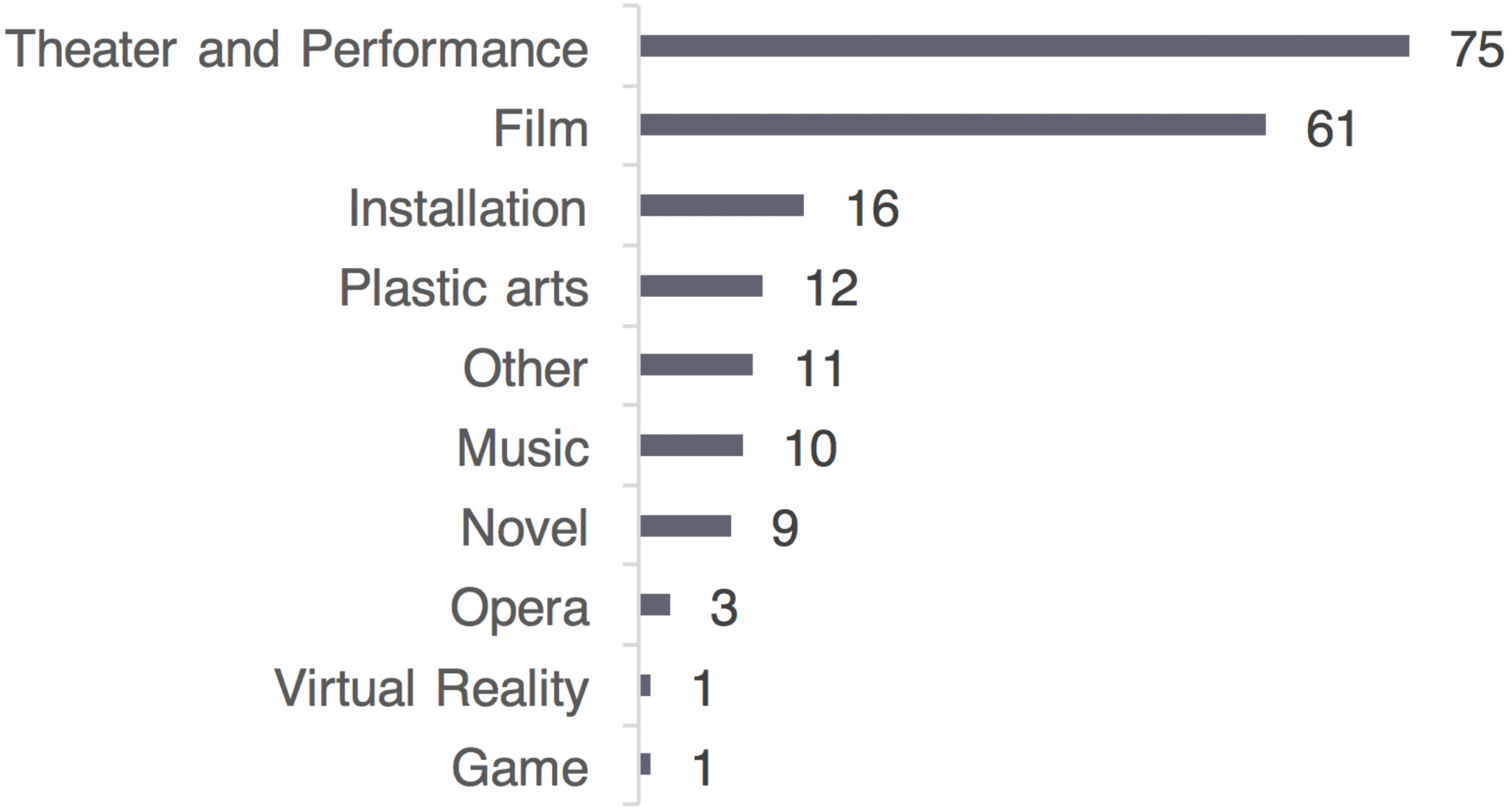
Theater and Performance
75
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Other
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Virtual Reality
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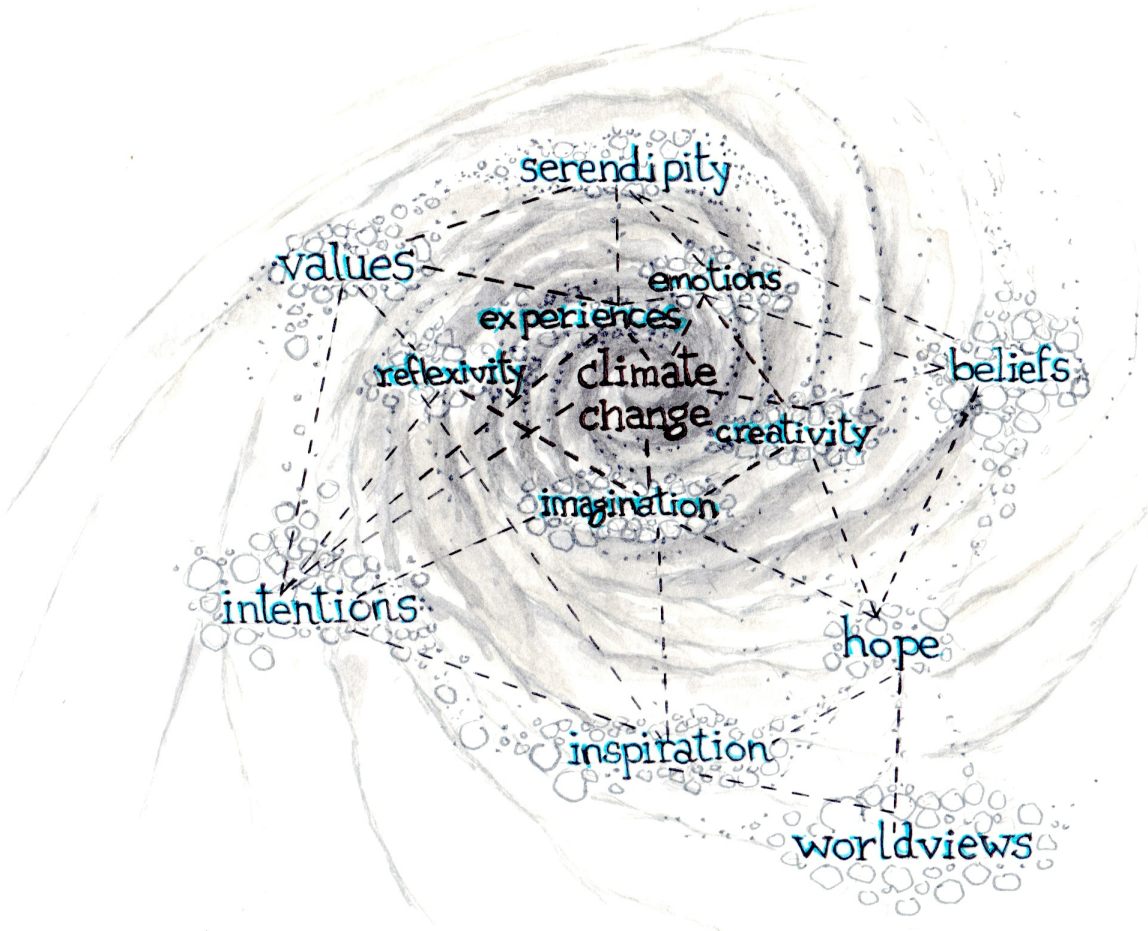
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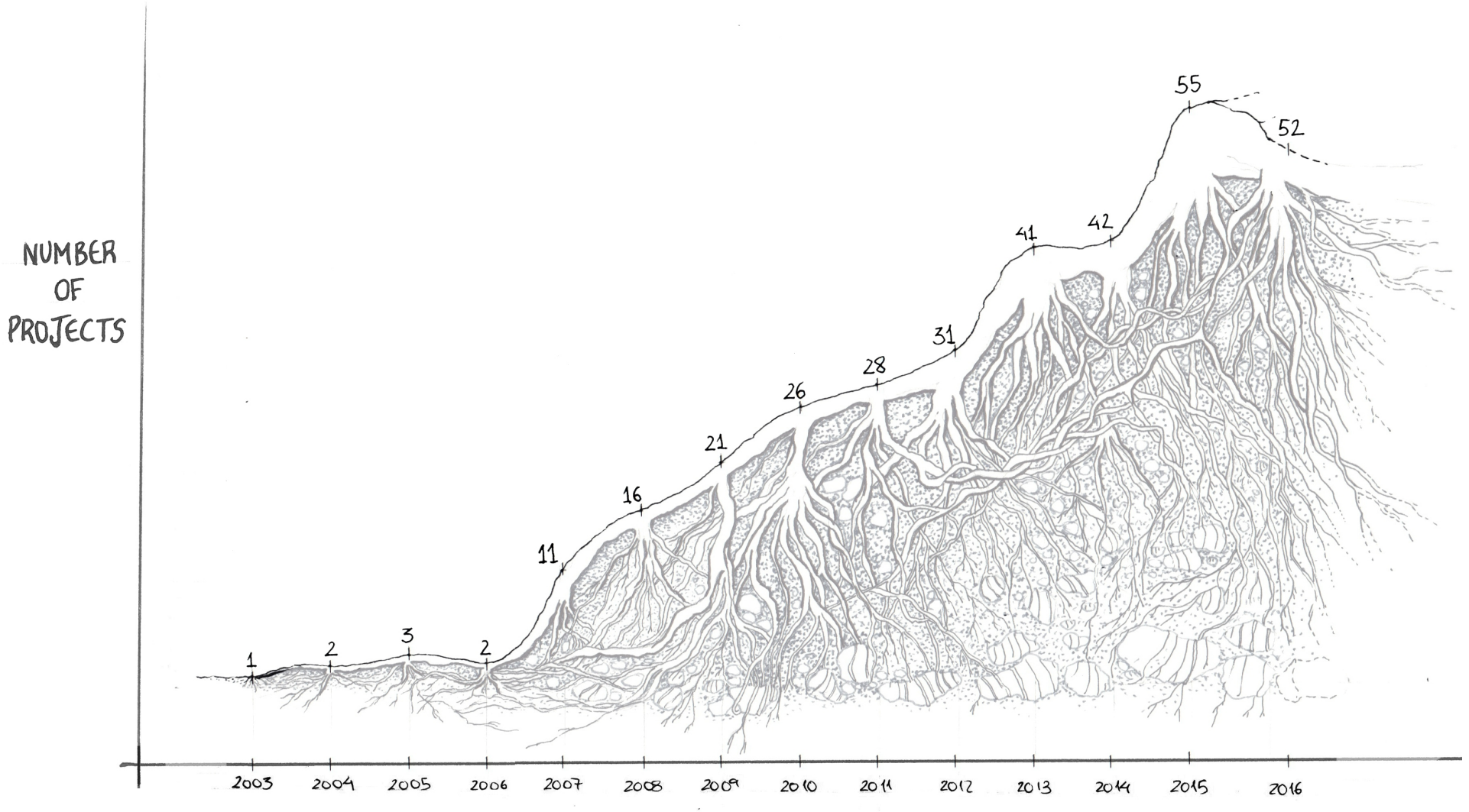
NUMBER OF PROJECTS
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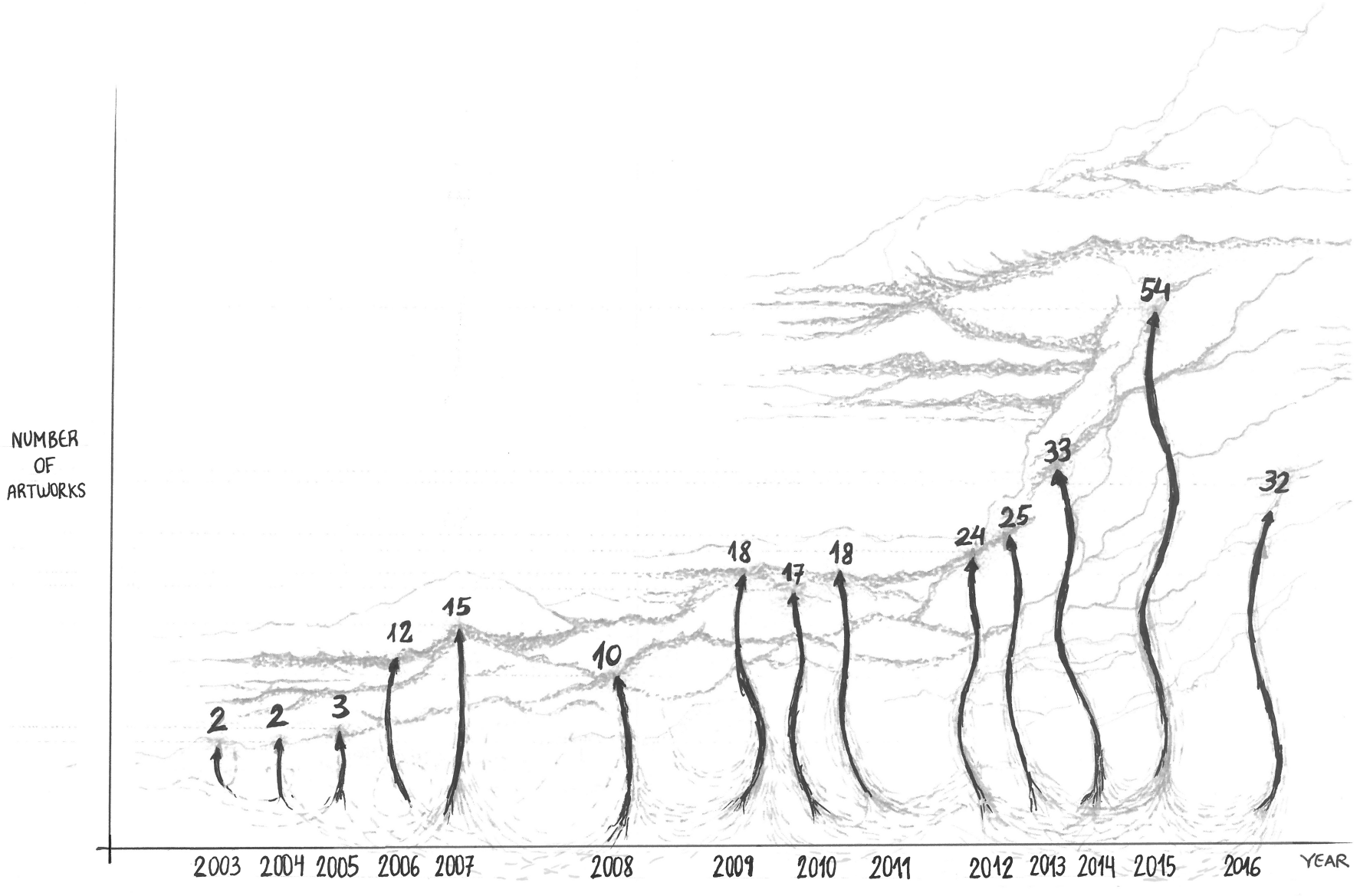
NUMBER OF ARTWORKS
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Conflict of interests

All authors declare no conflict of interests.

Supplementary Material

Contents

1. Methodological considerations

1.1. Method for mapping art and climate transformations literature

The first part of the article outlines the current perception across various literatures of the links between art and climate transformations. We used a number of approaches to identify relevant literature. First, a Web of Science (WoS) search was conducted using the search terms "art*" AND "transform*" AND "climate* change*". Most of the search results did not relate to art and after a screening process, the remaining 25 articles did not capture the linkages we were searching for. Second, we complemented this approach by developing a reference list compiled by the co-authors. All co-authors have worked within the field of art and sustainability, and some have focused on climate change in the North and the South. Finally, further references were found during the compilation of the climate-related art database (see below). Ultimately, the works selected for this study provide a thorough, though not complete, list of climate change-related art that reflect central arguments about art and climate transformations.

1.2. Definitions of climate-related art

Although the term climate-related art is not defined in art literature, we found it useful for this particular review. The term emphasises the attribution of "meaning" to a specific work. In art, the question "what is it about?" is often challenging. To define the term "climate-related art," we focused on activities, gestures, and interventions conducted through an art practice (such as performance, installation, music, film, theatre, and others) that are not necessarily nor exclusively aimed at communicating climate change, but are inspired or catalysed by the general discourse or scientific findings on climate change. We take climate-related artworks to be those whose content and themes are centred on climate change or those works the artists themselves define as being related to climate change.

1.3. Method for development of the climate-related art catalogue

We separated climate-related art into *artworks*, i.e. singular creations or events, and *projects*, i.e. long term initiatives, networks and projects.

The process for building the catalogue is described in Table 1. Two primary sources were used: expert consultation and web searches. We recognize that a significant number of climate-related art is not shown on websites, and that our methodological approach (Google searches) favours works from English-speaking countries. We sought to complement this by consulting with experts. Expert consultation supports the trends identified in the quantitative analysis.

Table 1. Process for the development of the catalogue

Step	**Task**	**Description**
1	Author and expert consultation	As a starting point for the catalogue, all co-authors were asked to identify climate change-related art projects/artworks that they were aware of.
2	General Google keyword search	Google keyword search (including "climate change" AND "art", etc.). This allowed for more specific art form searches: "climate change" AND "film" OR "theatre" OR "installation" OR "music" OR "photography" OR "drawing" OR "plastic arts" OR "sculpture" OR "street art" OR "game" OR

		"performance". These searches turned up specific examples of artworks and projects, as well as websites that featured various collections of works.
3	Tracing the path from artworks to exhibitions and projects	After identifying the most important projects that address climate change, we researched whether these had been part of any exhibitions in order to trace whether they were part of larger climate art projects.
4	Targeted Google keyword searches	These included searching the largest and most prestigious art museums. In addition, since initial Google searches returned projects mostly from the Western world, we searched specific countries (e.g. South Africa, Brazil, China) to broaden our scope.

1.4. Selection criteria

We have included artworks that address climate change in their content, and artworks where the artists themselves considerer the work to be about climate change. To further guide our project selection, we used three sub-criteria that relate to the projects' or artworks' entry point in relation to climate change.

1) **Climate-related themes:** Projects dealing with a specific climate change-related theme, like sea level rise, water scarcity, etc.
2) **Climate change discourse:** Projects inspired by climate change discourse and ideas around urgency, unequal effects, etc.
3) **Place-based:** Projects that explore a particular place, e.g. the Arctic, the city of Maputo, Mozambique, etc. Some projects might have a mix of different approaches and entry points.

To be included in the catalogue, at least one of the criteria needed to be met.

1.5. The architecture and development of the catalogue

Each *artwork* and *project* was classified according to the fields in Table 2.

Table 2. Catalogue fields

Field	**Description**
Identifier	Incremental number
Artwork or project name	Identification name
Project relationship	Internal link between artworks and projects
Institution/Initiator	Name of those conducting the project or artwork
Type	Artwork or Project (see Table 3 for further details)
Key narrative	Narrative description of the artwork or project as stated in artists or key reference
Art form	The artistic practice
Detailed art form	For those that have multiple art forms we listed which
Number of people involved	Estimate of engagement
Country	Country(ies) involved
Publication	If any publication has been done about it
Web link	Web page address

Key contact	Contact of the initiators
Date	Year(s) of activity

Table 3. Types of projects or artworks

Type	**Dimensions**
Project	A project is a carefully planned undertaking that is often designed to last over a period of time.
Platform	A platform provides an online space for exchange and dialogue.
Campaign	A campaign is instrumental and wants to achieve a specific goal (usually not long-term).
Exhibition	Exhibitions are presentations of more than one artworks organized by an institution. We only included exhibitions that explicitly had climate change as a main theme.
Network	Networks are collaborative initiatives.
Festival	A festival is an organized series of special events taking place during a rather short period of time.

1.6. Analysis

We conducted a qualitative analysis with a thematic analysis approach of the narrative statements available online used by initiators to describe artworks and projects. The goal was to identify climate-related themes and main goals (general orientations). Two of the authors identified climate-related themes (Table 4) and principal orientation of the (Table 5) by reading narratives independently and discussing definitions. Two authors coded the statements separately. Inter-coder reliability was addressed by discussing discrepancies (less than 10%).

Table 4. Climate related themes found in the project and artworks narratives

Climate related theme	**Description**
Futures	Seeking to identify desirable futures. Exploring multiple possible futures including dystopian ones.
Making phenomena visible	Representation of the biophysical impacts of climate change; Making problems visible across scales, developing networks; Visualizing planet's changing ecosystems
Human-nature relations	Finding novel ways to address how humans perceive and interact with nature
Climate responses	Identify, inspire and catalyse climate action
Risks	Raising awareness of risks and impacts of climate change, not only biophysical but in other domains
Place-based stories	Centred around local narratives of climate change

Table 5. Final list of core orientations of projects

Goal	**Description**
Risk perception and awareness	To raise awareness about phenomena, risks and solutions. Information sharing and dealing with emotional responses.
Future scenarios	To develop visions of the future or explore a range of imaginative futures.
Dialogue	To foster dialogue and facilitate interactions among various actors; knowledge integration.
Emotional and personal connection	To encourage emotional connection to a particular cause or place. Bringing climate change near.
Networks	To support climate action and connections.

1.6.1 Countries

We used the country where the artwork or project was presented. The artist's country of residence was not taken into consideration. Focusing on the presenting country may indicate where climate-related art is institutionalized and where funding is available.

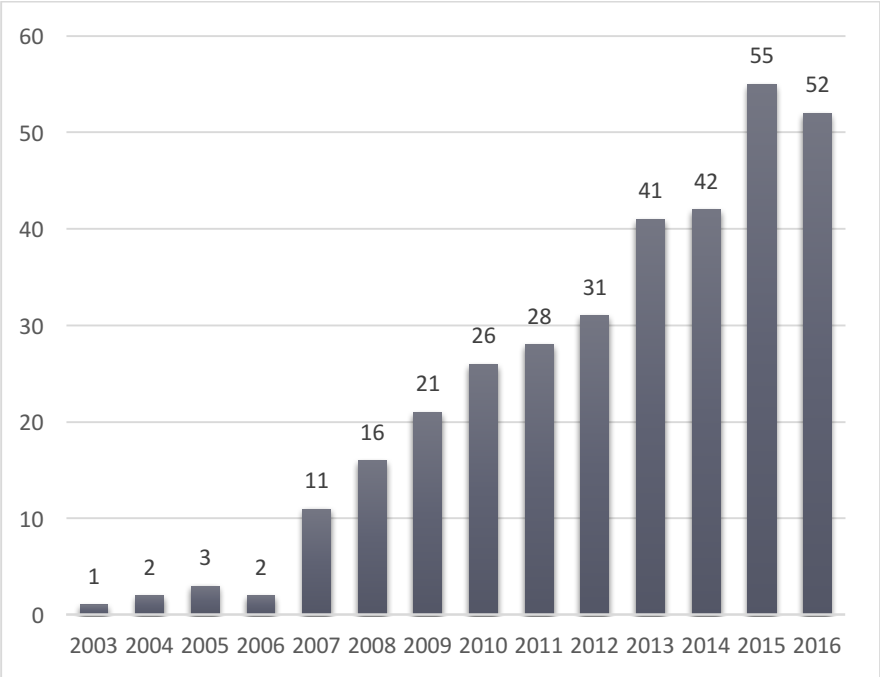
2. Supporting results

2.1. Totals

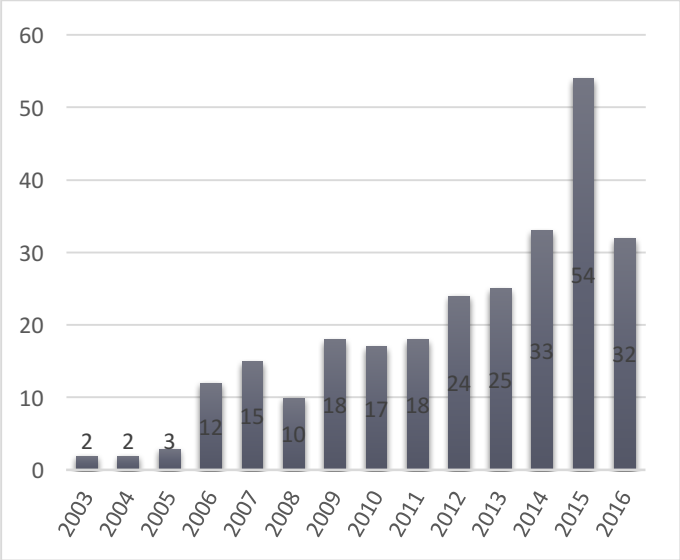
We have identified 199 artworks. Some artworks have been presented over the course of more than one year, therefore the total adds up to a number greater than 199.

We have identified 102 climate projects.

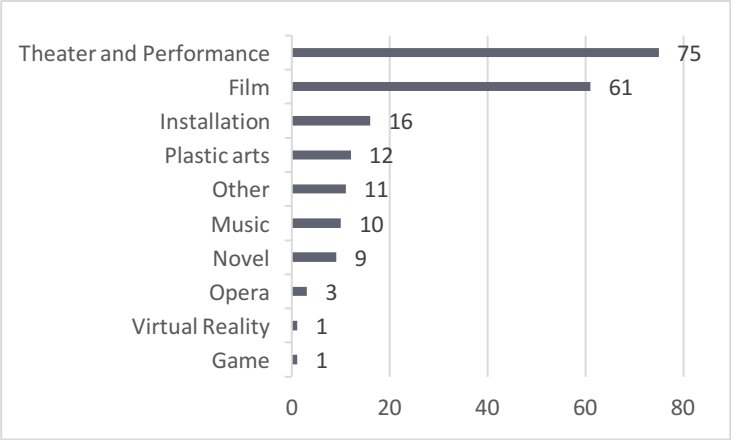
2.2. Number of projects



2.3. Number of artworks

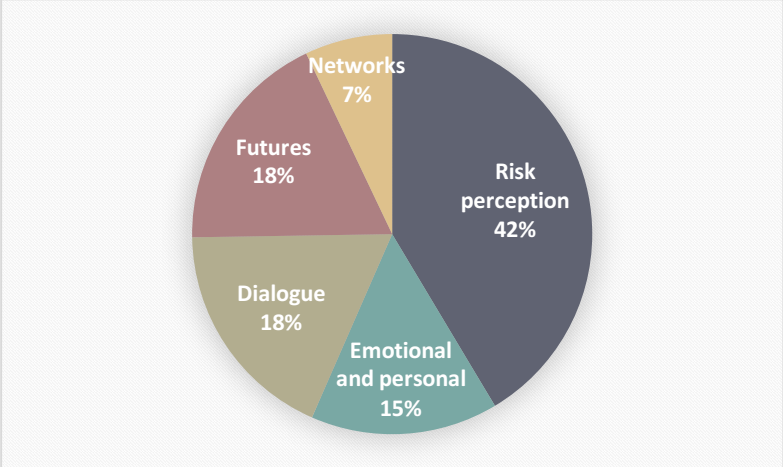


2.4. Artistic disciplines



2.5. Project orientation

We acknowledge that these five categories overlap. Our objective with these was not to create a framework for future analysis but to give the reader an idea of the range of goals artists have expressed. Projects tend to fit into more than one category but were categorized according to what we identified as being the main goal of the project. For instance, a project might use a participatory approach to explore possible futures, and through that process create networks. In that case, if the main goal of the project was to create a set of possible futures, we classified it as "Futures." If dialogue was framed as the most important aspect, we categorized it as "Dialogue."



3. Other climate change reviews

Climate-related art in specific disciplines has been reviewed by other studies. Climate change literature was reviewed by Trexler (2015) and Johns-Putra (2016). According to Johns-Putra (2016), climate change has emerged in the last five years as a dominant theme in literature, primarily in fiction. Other fields of literature also engaged are theatre and ecopoetry.

We added the number of novels mentioned by the Johns-Putra (2016) study to the catalogue. This data was used to analyse the number of artworks (Figure 3 in the main text). Up until 2011, Johns-Putra

(2016) found "about 30 novels" that fit the climate change fiction definition: "Fiction concerned with anthropogenic climate change or global warming as we now understand it." In the past five years, another "20 or so climate change novels [have appeared] that have gained significant critical and public attention". Their definition matches our definition of climate-related art.

4. References

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